ME-1309

INSTRUCTIONS

MODEL 607

Heterodyne Converter

PREFIX- 500

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ELECTRONIC INSTRUMENTS DIVISION

of Beckman Instruments, Inc.
composed of the former Berkeley
Division and Offner Operations

Beckman®

INSTRUCTION MANUAL

MODEL 607

Heterodyne Converter
PREFIX- 500

NASA Tracking Station
P. O. Box 1947
Titusville, Florida 32780

Beckman® INSTRUMENTS, INC.
BERKELEY DIVISION
2200 Wright Avenue
Richmond, California

REVISED OCT. '66

July 1963

WARRANTY

Instruments sold by Berkeley Division, Beckman Instruments, Inc., (hereafter called "the Company") are warranted only as stated below.

Subject to the exceptions and upon the conditions specified below, the Company agrees to correct, either by repair, or, at its election, by replacement, any defect of material or workmanship which develops within one year after delivery of the instrument to the original purchaser by the Company or by an authorized representative, provided that investigation and factory inspection by the Company discloses that such defect developed under normal and proper use.

The exceptions and conditions mentioned above are the following:

(a) Some components and accessories by their nature are not intended to, and will not, function one year. If any such component or accessory manufactured by the Company and part of the item sold fails to give reasonable service for a reasonable period of time, the Company will, at its election, replace or repair such component or accessory. What constitutes reasonable service and what constitutes a reasonable period of time shall be determined solely by the Company after the Company is in posession of all the facts concerning operating conditions and other pertinent factors and after such component or accessory has been returned to the Company, transportation prepaid.

(b) All instruments claimed defective must be returned to the Company, transportation charges prepaid, and will be returned to the customer with the transportation charges collect, unless the item is found to be defective in which case the Company will pay all transportation charges.

(c) The Company makes no warranty concerning components or accessories not manufactured by it, such as tubes, fuses, batteries, etc. However, in the event of the failure of any component or accessory not manufactured by the Company, the Company will give reasonable assistance to the purchaser in obtaining from the respective manufacturer whatever adjustment is reasonable in the light of the manufacturer's own warranty.

(d) Except as stated above, the Company makes no warranty, express or implied (either in fact or by operation of law), statutory or otherwise; and, except to the extent stated above, the Company shall have no liability under any warranty, express or implied (either in fact or by operation of law), statutory or otherwise.

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(f) Representations and warranties made by any person, including representatives of the Company, which are inconsistent or in conflict with the terms of this warranty (including but not limited to the limitation of the liability of the Company as set forth above) shall not be binding upon the Company unless reduced to writing and approved by an officer of the Company.

(g) This warranty shall be governed by the laws of the State of California.

Claims for damage in shipment should be filed promptly with the transportation company.

All correspondence concerning the instrument should specify the model and serial number. This information appears on the company name plate. Any inquiry concerning details of operation, possible modifications, etc., should be addressed to the Sales Department, Berkeley division of Beckman Instruments, Inc., Richmond 4, California.

REPAIR SERVICE

Experienced service personnel and special test equipment are available at the factory to perform any necessary repairs. Every effort will be made to expedite the repair of instruments returned for servicing. Repair work will be performed only upon receipt of a written purchase order or authorization. Instruments to be repaired should be addressed to SERVICE AND REPAIR DEPARTMENT with transportation charges prepaid. Repaired instruments will be returned to the purchaser with transportation charges collect.

Berkeley reserves the right to make changes in design at any time without incurring any obligation to modify equipment previously purchased to conform to subsequent design changes.

BERKELEY DIVISION
BECKMAN INSTRUMENTS, INC.

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SECTION 1

INTRODUCTION

1.1 GENERAL

The Beckman Model 607 Heterodyne converter is an all solid-state plug-in which extends the frequency measuring range of the Beckman Model 6146 or 6126. Using heterodyning frequency conversion techniques, the Model 607 increases the maximum frequency counting range of the Model 6146 or 6126 from 25 mc to 1000 mc while maintaining the accuracy of the master instrument.

The frequency of an unknown input signal is determined by adding the reading on the Model 607 REFERENCE-MEGACYCLES dial to the reading displayed on the master instrument (Model 6146 or 6126).

1.2 SPECIFICATIONS

See Table 1-1 for specifications.

Table 1-1

Frequency Range	25 mc to 1000 mc
Sensitivity	100 millivolts rms
Dynamic Range	100 millivolts to 1 volt rms (2 volts max.)
Input Connector	Type BNC female
Input Impedance	50 ohms nominal
Input Reference Frequency	10 mc
Output Frequency	Pulse output to drive counter logic in the 500 kc to 20.5 mc band.

Table 1-1 (continued)

Output Amplitude	0.5 volts, 20 nanoseconds
Accuracy	Maintains the accuracy of reference frequency of master instrument
Temperature Range	Operating: -20 degrees C to +65 degrees C Storage: -55 degrees C to +75 degrees C
Power Requirements	100 milliamperes at +15 volts dc 10 milliamperes at -15 volts dc All power supplied by master instrument
Dimensions	4-3/4" H x 5-3/8" W x 11-1/2" D
Weight	10-1/2 pounds

1.3 APPLICATIONS

The Model 607 and Model 6146 or 6126 combination is adaptable to applications that require quick, accurate measurements over a wide band of frequencies (0 to 1000 mc). Calibration of transmitters and receivers, monitoring of high frequency carriers, and adjustment of oscillators and signal generators are some of the uses of this converter.

SECTION 2

OPERATION

2.1 GENERAL

Designed for operation with the Beckman Model 6146 or 6126, the Model 607 extends the frequency measuring range of these instruments by using heterodyning methods of frequency conversion. The Model 607 uses a single tuning control to select a reference frequency near an unknown input frequency. The value of the input frequency is equal to the reference frequency plus the difference frequency as displayed on the master instrument.

2.2 INSTALLATION

If the Model 607 is obtained separately from the master instrument, follow these steps for installation:

1) Remove the installed plug-in as follows:

   a) Turn the securing rod (left side of plug-in) counterclockwise until the plug-in is free to slide forward.

   b) Pull out the plug-in.

2) Slide the Model 607 into the master instrument.

3) Secure the Model 607 by tightening the securing rod. Guide pins at the rear of the plug-in insure that connectors mate properly. The Model 607 should fit flush with the master instrument front panel.

2.3 APPLYING POWER

All power (refer to Table 1-1) is supplied by the master instrument via the mating connectors at the rear of the plug-in.

2.4 CONTROLS AND CONNECTORS

Refer to Table 2-1 for the function of the operating controls and connectors. Figure 2-1 shows their locations.

Table 2-1

Controls and Connectors

(1)	* MASTER-PLUG IN Selector	In PLUG IN, completes interlock of electrical connections for operation of Model 607 with master instrument. In MASTER, restores operation to INPUT's X and Y, TRIGGER and ATTEN FACTOR controls, and SLOPE switches of master instrument. Makes Model 607 inoperative.
(2)	Tuning Control	Selects desired reference frequency. Tunes in steps of 20 mc from 20 to 980 mc.
(3)	REFERENCE-MEGACYCLES Dial	Indicates reference frequency as selected by tuning control.
(4)	LEVEL Meter	Indicates signal strength of beat frequency at amplifier output. For maximum accuracy the readings should be kept in the green area of the meter.
(5)	INPUT Connector	Type BNC female. For application of input signals from 25 mc to 1000 mc.
6	Rear Panel Connectors. (Not Shown in Figure 2-1)	Mate with connectors in master instrument to provide necessary power supply voltages and to complete signal paths to Model 607.

* Circled numbers relate to locations shown in Figure 2-1.

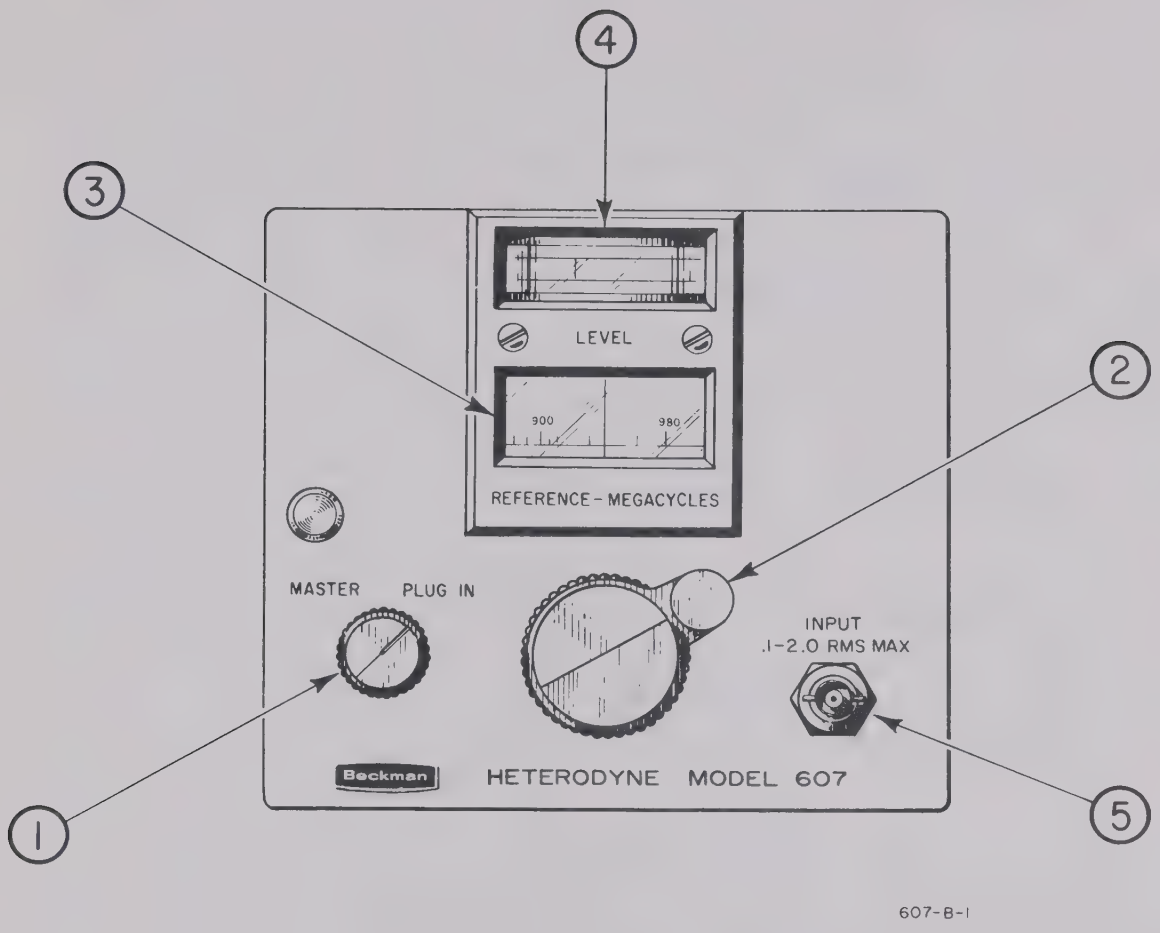


FIG. 2-1. Model 607 Front Panel.

2.5 OPERATING PROCEDURE

Before using the Model 607, the operator should be familiar with the operating procedures given in the instruction manual for the Model 6146 or 6126. Paragraph 2.5.1 of this manual includes a brief outline of the settings used on the master instrument for operation with the Model 607.

2.5.1 Operation of the Master Instrument

To operate the master instrument, follow these steps:

1) Set the MODE selector to E/UT X.

2) Set the TIME selector for the desired measurement resolution. (See Table 2-2).

3) With steps 1 and 2 completed, the master instrument will measure the converter output.

Table 2-2

Frequency Resolution with different TIME selector settings. (MODE selector at E/UT X).

Input Frequency = 409.1234567 mc	Reference Setting = 400 mc	
TIME Setting	Master Instrument Display	Measurement Resolution
.1 μs	No display	
1 μs	00000009. MC	409. mc
10 μs	0000009.1 MC	409.1 mc
0.1 ms	000009.12 MC	409.12 mc
1 ms	00009.123 MC	409.123 mc
10 ms	0009123.4 KC	409.1234 mc
0.1 sec	009123.45 KC	409.12345 mc
1 sec	09123.456 KC	409.123456 mc
10 sec	9123.4567 KC	409.1234567 mc

2.5.2 Operation of the Converter

When operating the Model 607 Heterodyne unit, it is important to note that there are two methods of selecting references. In the 20 - 200 mc range, the reference frequencies are selected by means of switched contacts. When using a particular reference frequency in this range, align the hair-line indicator exactly with the REFERENCE-MEGACYCLES dial marking corresponding to the desired frequency. Do not attempt to tune for maximum meter deflection in this range.

In the 220 - 980 mc range, the reference frequencies are selected by means of a tuneable cavity which is geared to the REFERENCE-MEGACYCLES control. Select an individual reference in this range by setting the hair-line indicator to coincide roughly with the desired reference, and then peak the level meter deflection by means of the REFERENCE-MEGACYCLES tuning control.

To operate the converter, follow these steps:

1) Set MASTER-PLUG IN selector to PLUG IN.

2) Set REFERENCE-MEGACYCLES dial to the lower reference frequency (20 mc).

3) Connect the unknown frequency to INPUT connector. Signal must be within the dynamic range (100 millivolts to 1 volt rms) of the converter, and between 25 - 1000 mc.

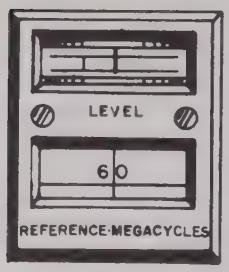
4) Using the method of reference selection detailed above, select progressively higher references, one at a time, until a level meter deflection in the green portion of the meter face is obtained for a counter reading of 20.5 mcs or less. If the counter display is higher than 20.5 mcs the first time a deflection in the green portion of the level meter is attained, advance to the next higher reference frequency. For example, if the reference frequency is 60 mcs and the counter displays 23 mcs, advance to the next higher reference (80 mcs) and a readout of 3 mcs should be obtained.

5) Add the REFERENCE-MEGACYCLES dial reading to the reading displayed on the counter to determine the input frequency. For example, if the reference reading is 200 mc and the reading on the counter is 8.25 mc, the input frequency is 200 + 8.25 or 208.25 mc.

   As shown in Figures 2-2, 2-3, and 2-4 it is possible to obtain two and sometimes three different beat frequencies with the same input signal. For example, if the input signal (f_x) is 65 mc and the reference frequency (f_r) is 60 mc, the difference (beat) frequency (f_d) is 5 mc ($f_x - f_r = f_d$). With the same input of 65 mc and a reference of 80 mc, the beat frequency is 15 mc ($f_r - f_x = f_d$).

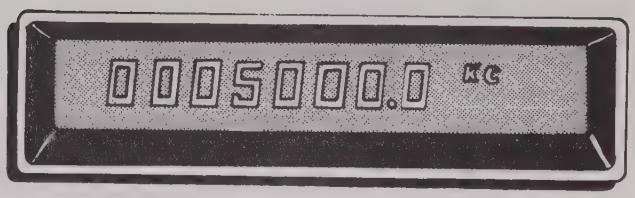
INPUT FREQUENCY 65 MC

MODEL 607



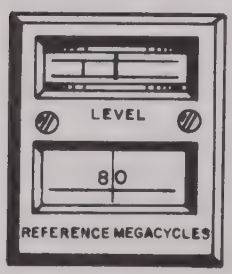
REFERENCE
60 MC

COUNTER READOUT



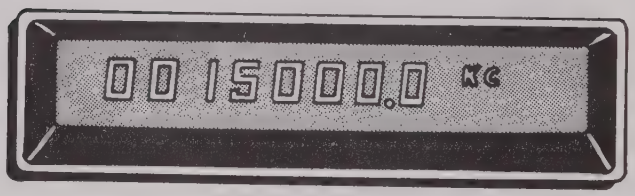
DIFFERENCE FREQUENCY
5 MC

MODEL 607



REFERENCE
80 MC

COUNTER READOUT



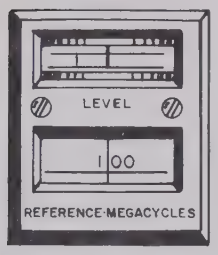
DIFFERENCE FREQUENCY
15 MC

607-A-1

FIG. 2-2. Frequency Indication with 65 MC Input.

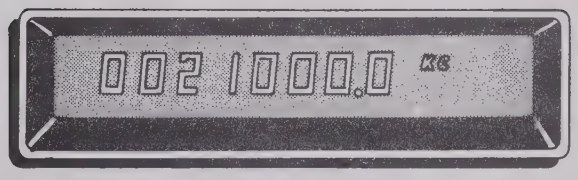
INPUT FREQUENCY 121 MC

MODEL 607



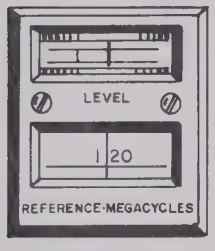
REFERENCE
100 MC

COUNTER READOUT



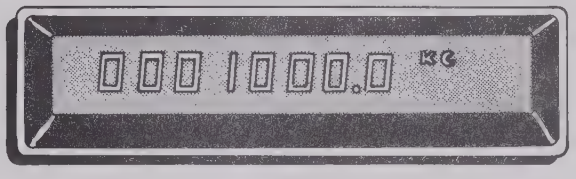
DIFFERENCE FREQUENCY
21 MC

MODEL 607



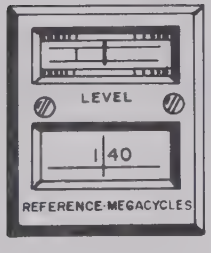
REFERENCE
120 MC

COUNTER READOUT



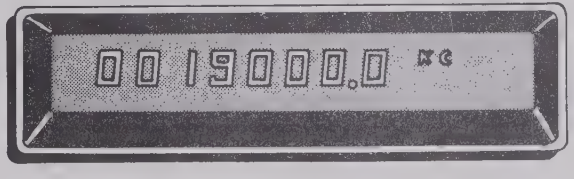
DIFFERENCE FREQUENCY
1 MC

MODEL 607



REFERENCE
140 MC

COUNTER READOUT



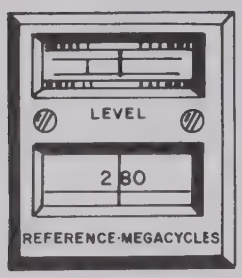
DIFFERENCE FREQUENCY
19 MC

607-A-2

FIG. 2-3. Frequency Indication with 121 MC Input.

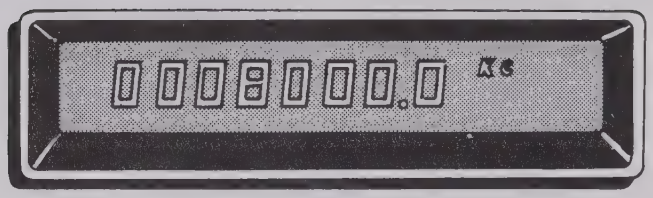
INPUT FREQUENCY 288 MC

MODEL 607



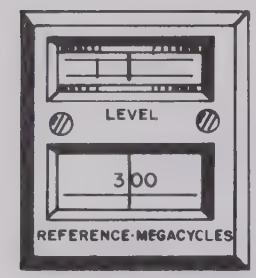
REFERENCE
280 MC

COUNTER READOUT



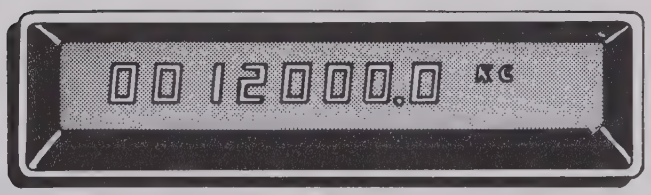
DIFFERENCE FREQUENCY
8 MC

MODEL 607



REFERENCE
300 MC

COUNTER READOUT



DIFFERENCE FREQUENCY
12 MC

607-A-3

FIG. 2-4. Frequency Indication with 288 MC Input.

A third beat occurs if the input signal is close to one of the reference frequencies. For example, with a 121 mc input frequency, the 100 mc reference will produce a 21 mc beat, the 120 mc reference will produce a 1 mc beat, and the 140 mc reference will produce a 19 mc beat. In all cases, the correct answer is easily reached by following the steps of the operating procedure.

2.5.3 Spurious Responses

When high level signals are being measured (in the order of 1 volt rms), the second harmonic of an input signal can cause a deflection on the LEVEL meter and a corresponding erroneous reading on the counter. For example, with an input frequency of 62 mc, there could possibly be a deflection into the green portion of the level meter with a reference of 120 mc (124 mc is the second harmonic of 62 mc), and a resulting beat frequency of 4 mc. If the operator suspects that he has tuned to the second harmonic of the input, he should repeat the steps of the operating procedure.

A small spurious response can sometimes be observed when the input signal is approximately twice the reference being tuned. For example, a 300 mc reference produces a 600 mc second harmonic. If the input is 605 mc and the reference setting is 300 mc, there could be a small indication on the level meter, and a beat frequency indication of 5 mc displayed on the counter. The instrument is designed so that this spurious response does not cause a level meter indication in the green region. Hence, the correct answer can always be obtained by simply following the steps of the operating procedure.

2.5.4 Level Meter - Interpretation of Red Zone

The level meter is set to give a relative indication of signal level reaching the counter. The red zone is somewhat arbitrary, and does not imply a minimum level necessary for proper operation. Rather, it indicates a re- tion of operation where ambiguous answers could be obtained if the operating procedure is not followed carefully. Typically, this zone is set for about 50 - 60 millivolts at the input, at room temperature (25 degrees C).

Proper operation will be obtained at lower levels. If meter deflection is observed, and a stable count achieved, sufficient signal is present to provide proper counter operation. This can be easily checked by observing the counter indication, and will occur with input signals less than 50 millivolts.

SECTION 3

CIRCUITS

3.1 GENERAL

Frequencies from 25 mc to 1000 mc are measured by heterodyning the unknown input signal with a known reference signal to produce a difference frequency, which is measured by the master instrument.

As shown in Figure 3-1, Model 607 comprises a multiplier, three harmonic generators, two balanced mixers, two low-pass filters, and a video amplifier.

The multiplier, driven by the 10 mc reference from the master instrument, provides two outputs to the harmonic generators, which in turn generate the reference selected by the tuning control. The reference frequency drives one of the balanced mixers, which is also being fed by the unknown input signal. The beat frequency obtained when these signals are mixed is fed through one or both low-pass filters. (The 10 mc filter is switched into the circuit for references of 20 and 30 mc). The output of the 20 mc filter feeds the video amplifier for amplification and pulse-shaping. Output "count" pulses are routed to the gate-control section of the master instrument.

3.2 X2 MULTIPLIER

As shown in Figure 3-2, the X2 multiplier comprises two transistor stages: a multiplier stage tuned to 20 mc, and an output buffer amplifier stage. A capacitive divider at the multiplier input separates the 10 mc reference to drive the 20-30 mc harmonic generator.

The 20 mc output of the multiplier drives either the 40-200 mc harmonic generator or the 220-980 harmonic generator depending on the setting of the tuning control. Switching is accomplished by diodes CR1 and CR9. For example, with a selected reference of 80 mc, CR9 will have +15 volts applied to its anode through S3A, and the diode will be forward biased. The 20 mc reference will pass through this conducting diode and drive the 40-200 mc harmonic generator. In this case, diode CR1 will be off.

3.3 HARMONIC GENERATORS

Reference frequencies from 20 mc to 980 mc are produced by three independent harmonic generators: the 20-30 mc generator, the 40-200 mc

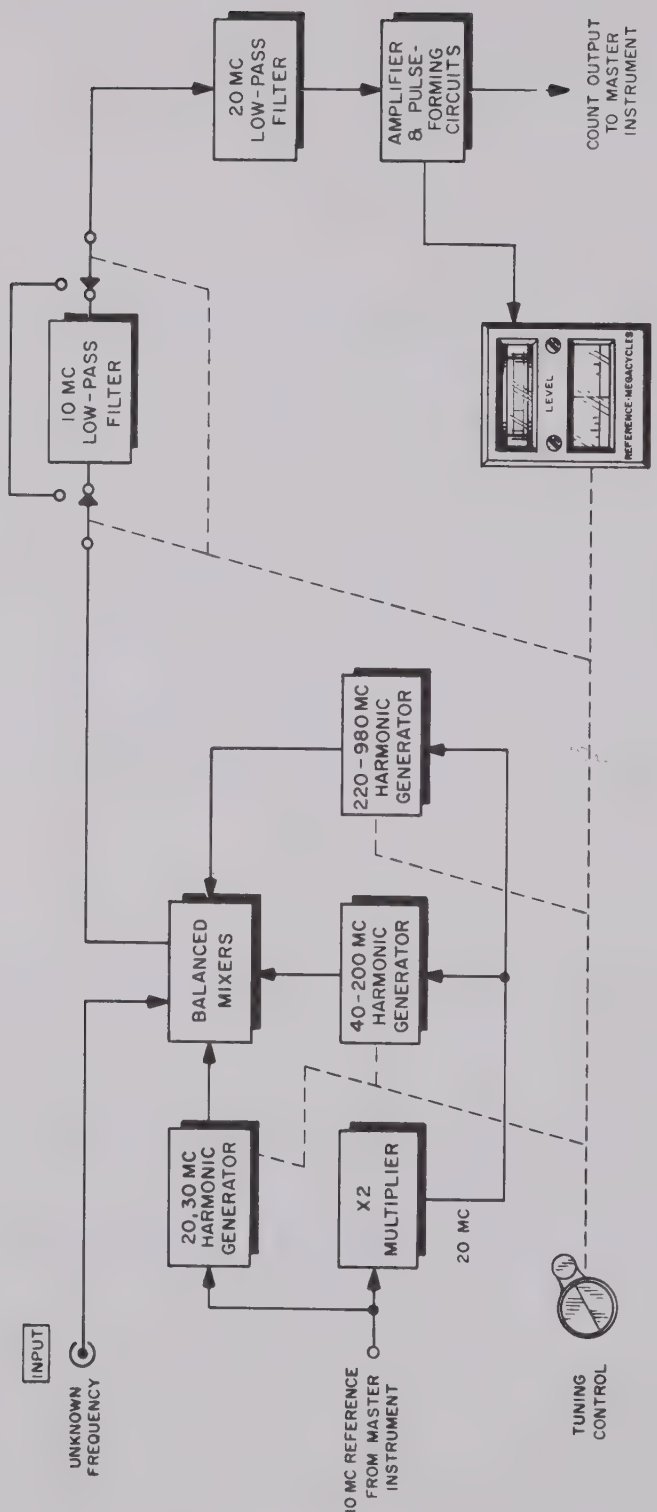


FIG. 3-1. Model 607 Block Diagram.

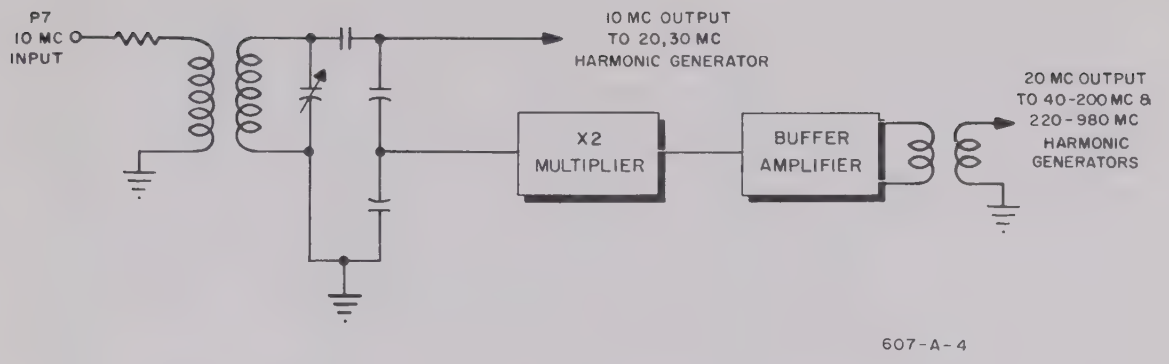


FIG. 3-2. Multiplier Simplified Schematic.

generator, and the 220-980 mc generator. Depending on the reference frequency selected, one of the harmonic generators drives one of the balanced mixers. See Figures 3-3, 3-4, and 3-5, simplified diagrams of the harmonic generator connections.

3.3.1 The 20-30 mc Harmonic Generator

Nonlinear operation of transistor Q1 produces reference frequencies of the 20-30 mc harmonic generator. The reference selected (20 or 30 mc) by the tuning control is generated in L5, and inductively coupled to the low frequency balanced mixer.

3.3.2 The 40-200 mc Harmonic Generator

The 40-200 mc harmonic generator provides reference frequencies of 40, 60, 80 . . . 200 mc (20 mc increments). These frequencies are generated by limited conduction angle and snap-off current in CR10. A reference in the 40-200 mc range is selected by changing the resonant frequency of L3 and the associated tuning capacitors. L3 is inductively coupled to the low frequency balanced mixer.

3.3.3 The 220-980 mc Harmonic Generator

The snap-off action of diode CR2 generates reference frequencies from 220 mc to 980 mc. A reference in this range is selected by tuning a resonant cavity. The selected reference is inductively coupled to the high frequency balanced mixer.

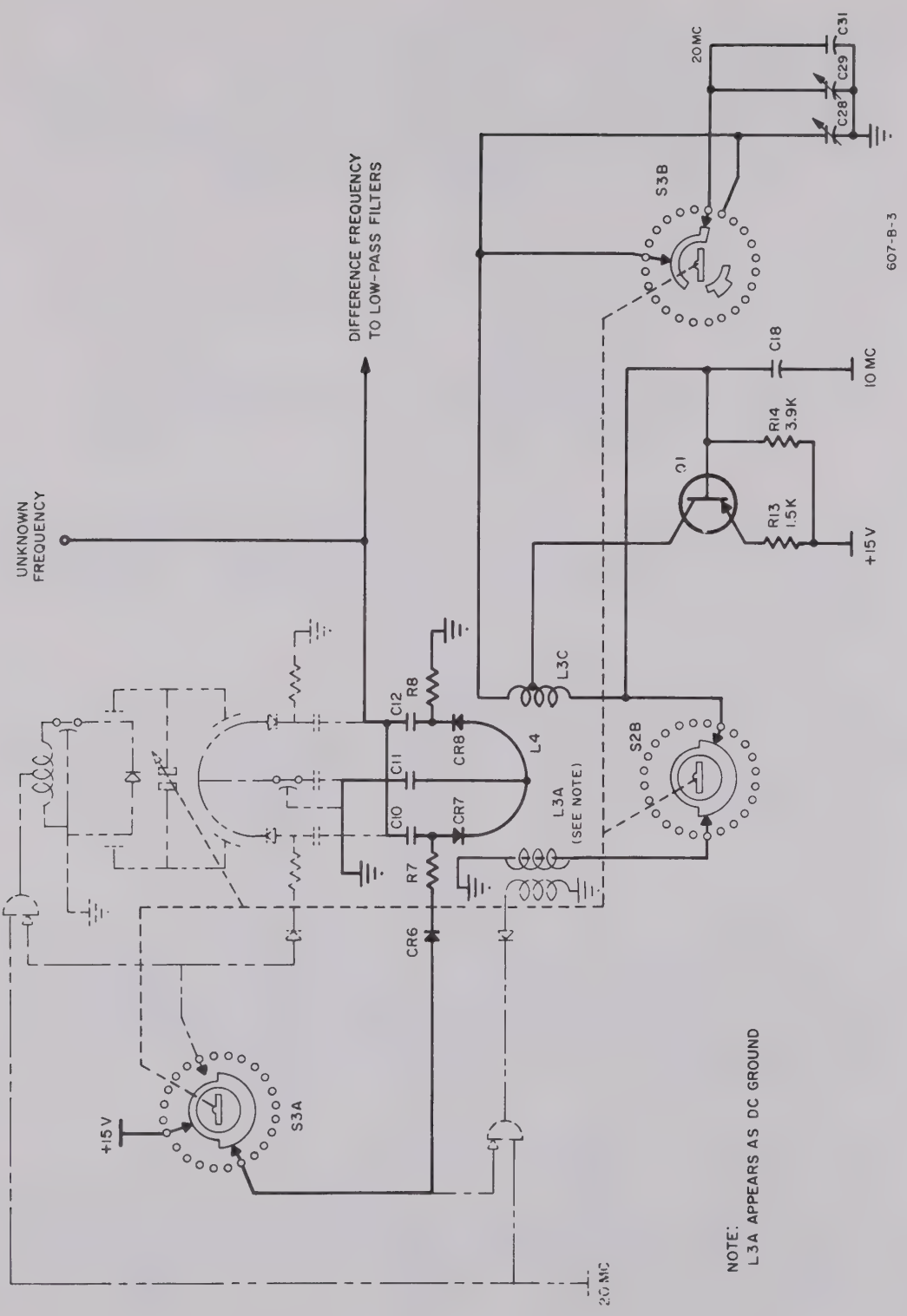


FIG. 3-3. Harmonic Generator Simplified Schematic (20, 30 MC Circuit Shown Heavy).

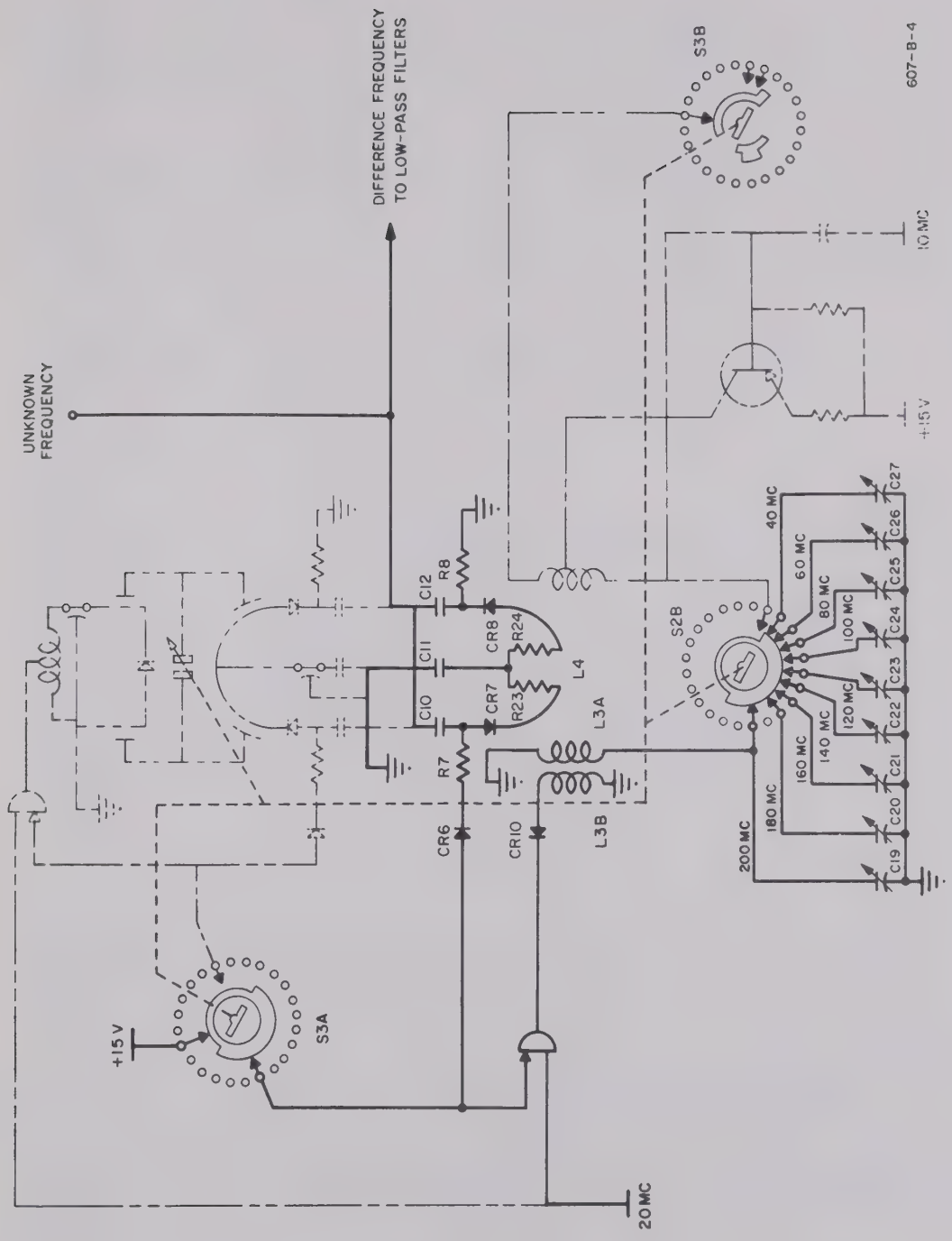


FIG. 3-4. Harmonic Generator Simplified Schematic (40-200 MC Circuit Shown Heavy).

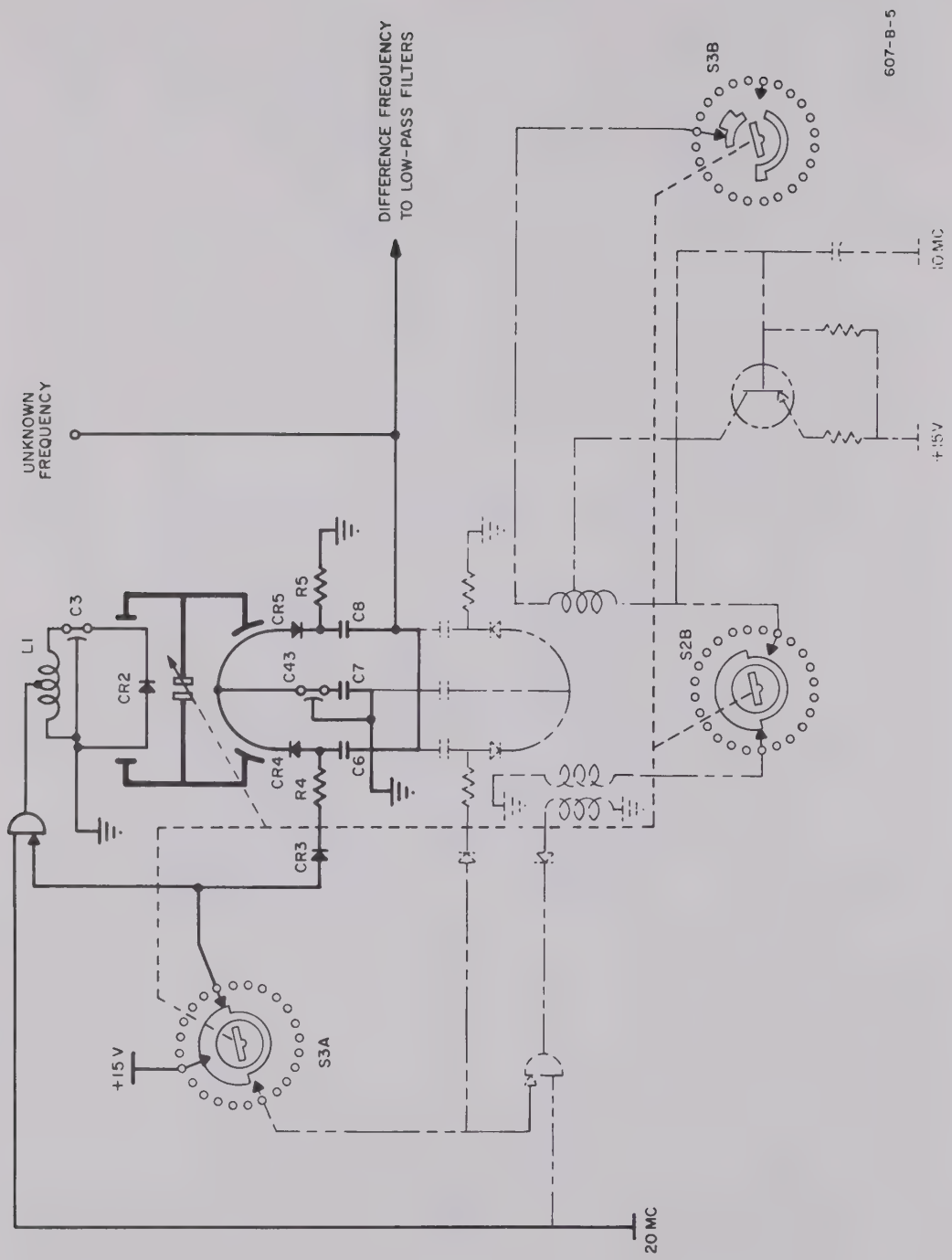


FIG. 3-5. Harmonic Generator Simplified Schematic (220-980 MC Circuit Shown Heavy).

3.4 BALANCED MIXERS

There are two balanced mixers: one mixer for reference frequencies from 20 to 200 mc, and one for reference frequencies from 220 to 980 mc. The mixers are similar, and only one is selected for a given reference.

Mixing the unknown input signal with the reference frequency produces four frequencies at the output of the mixer: 1) the sum (reference + unknown), 2) the difference (unknown - reference or reference - unknown), 3) the reference (this would be zero if the mixer balance was perfect), and 4) the unknown. The bandpass (10 mc or 20 mc) of the filter circuits prevents all of these frequencies, except the difference, from driving the amplifier.

The balanced mixer keeps the reference level in the output low, keeps the signal-to-noise ratio high, and increases conversion efficiency.

3.5 LOW-PASS FILTERS

The low-pass filters prevent the unknown and reference frequencies from driving the amplifier, and provide a low-impedance signal path to the amplifier for the difference frequency.

When 20 and 30 mc references are used, the 10 mc filter is switched in by S1A and S1B to prevent reference and unknown frequencies in the 20 to 30 mc range from passing through the 20 mc filter to the amplifier. Therefore, with the 10 mc filter switched in, frequencies above 10 mc cannot drive the amplifier. With references from 40 to 980 mc, the difference frequency is routed around the 10 mc filter to the 20 mc filter.

3.6 VIDEO AMPLIFIER

The difference frequency is fed through the 20 mc filter to the video amplifier for amplification and pulse shaping. The video amplifier comprises transistor amplifiers Q1 through Q5, an AGC circuit (automatic gain control), and a meter circuit.

As shown in Figure 3-6, part of the ac signal at the collector of Q3 is rectified, amplified by Q6, and fed back to a variable attenuator at the base of Q1 for AGC. The input signal is attenuated by varying the dynamic resistance of CR1 with a dc current proportional to the ac signal at the collector of Q3. As the conduction of CR1 increases, the degree of attenuation increases, and the output of the amplifier decreases to maintain a constant output.

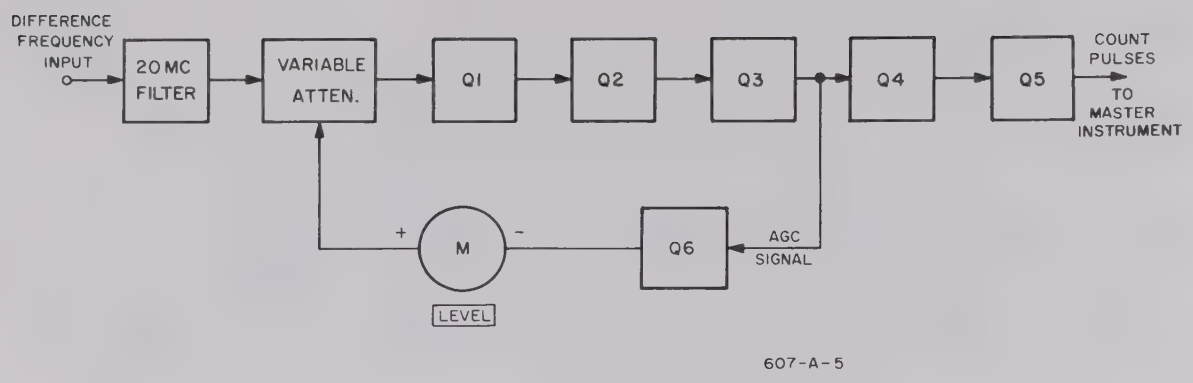


FIG. 3-6. Video Amplifier Block Diagram.

Tunnel diode CR7 shapes the amplified ac signal at the collector of Q4 into sharp pulses, which are amplified by Q5. The "count" pulse output of Q5 is fed to the gate-control section of the master instrument.

The meter circuit consists of nonlinearizing diode CR2 and LEVEL meter M1 connected in the AGC feedback path.

SECTION 4

ADJUSTMENTS

4.1 GENERAL

Adjustment procedures outlined in this section should be performed only when absolutely necessary (e.g. after corrective maintenance). Certain factory adjustments have been omitted from the manual, and should not be attempted.

4.2 TEST EQUIPMENT REQUIRED

The following test equipment is required for servicing the Model 607:

1) A volt-ohmmeter with 100 kohm/volt sensitivity (Simpson Model 269 or equivalent).

2) An oscilloscope with a bandpass of 20 mc and an input impedance of 1 megohm shunted by 14 pf (Tektronix Model 541 or equivalent).

3) A signal generator (or generators) to cover the 20-980 mc frequency range with a minimum of 100 millivolts rms output.

4) Extension cable 15" long.

4.3 220-980 MC HARMONIC GENERATOR ADJUSTMENT

Conditions:

1) Unit energized

2) No input signal

3) MASTER-PLUG IN selector to PLUG IN

4) Top cover removed

Procedure:

1) Set REFERENCE-MEGACYCLES dial to 980.

2) Measure dc voltage at 220-980 BIAS test point (see Figure 4-1). Typical voltage at this point is +15 to +25 volts dc.

3) Adjust multiplier capacitors C1, C7, C10, and C14 for maximum dc voltage at 220-980 BIAS test point. Capacitors are accessible through holes in the bottom cover.

4) Adjust L1 (Figure 4-1) for maximum dc voltage at 220-980 BIAS test point

NOTE

Due to interaction between multiplier and L1 adjustments, repeat steps 3 and 4 alternately until maximum dc voltage is attained at the 220-980 BIAS test point.

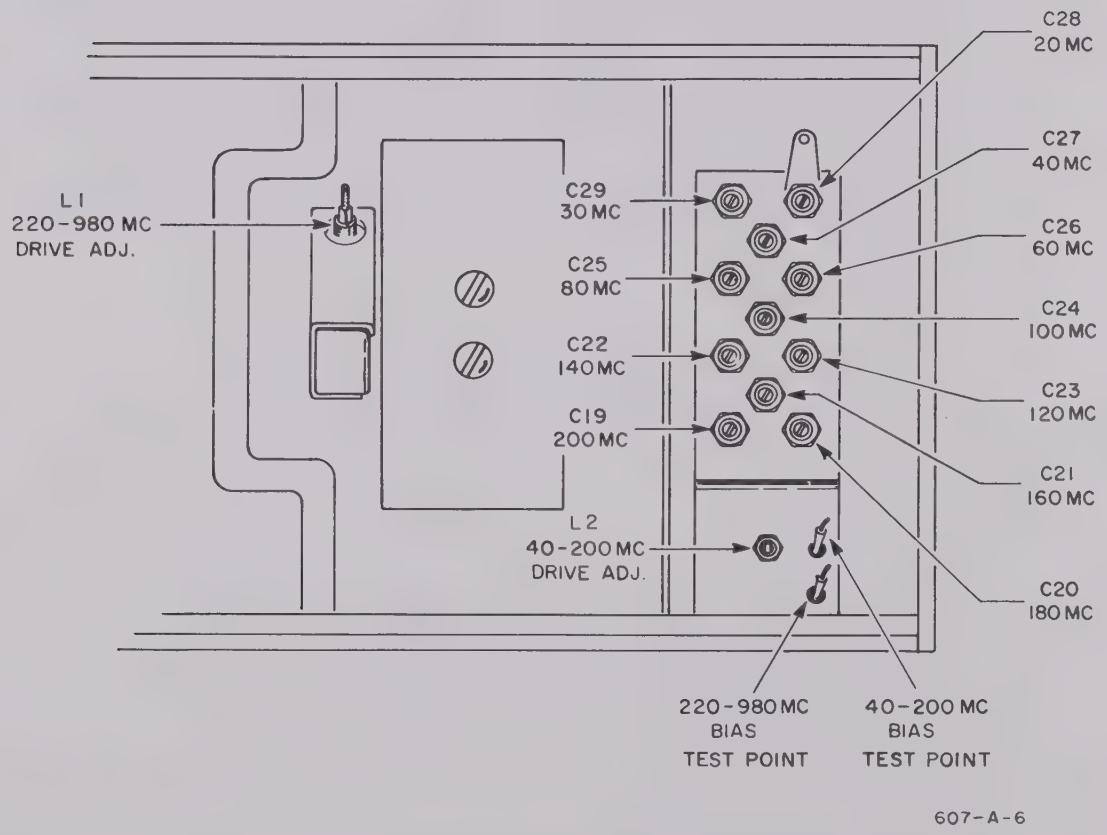


FIG. 4-1. Top View of Chassis Showing Harmonic Generator Adjustments.

4.4 40-200 MC HARMONIC GENERATOR ADJUSTMENT

Conditions:

1) Unit energized
2) No input signal
3) MASTER-PLUG IN selector to PLUG IN
4) Top cover removed

Procedure:

1) Set REFERENCE-MEGACYCLES dial to 200.
2) Measure dc voltage at 40-200 BIAS test point (Figure 4-1). Typical voltage at this point is +2 to +10 volts dc.
3) Adjust L2 for maximum dc voltage at 40-200 BIAS test point.

NOTE

It is not necessary to readjust the multiplier if it was adjusted as stated in Section 4.3.

4.5 REFERENCE FREQUENCY ADJUSTMENT (40-200 MC)

Conditions:

1) Unit energized
2) MASTER-PLUG IN selector to PLUG IN
3) Top cover removed

Procedure:

1) Set REFERENCE-MEGACYCLES dial to 200.
2) Apply 201 mc, 100 millivolts rms at INPUT connector.

3) Monitor the signal at the base of Q4, video amplifier board (Figure 4-2) with an oscilloscope. A 1 mc beat frequency should appear if the reference is tuned to the correct harmonic.

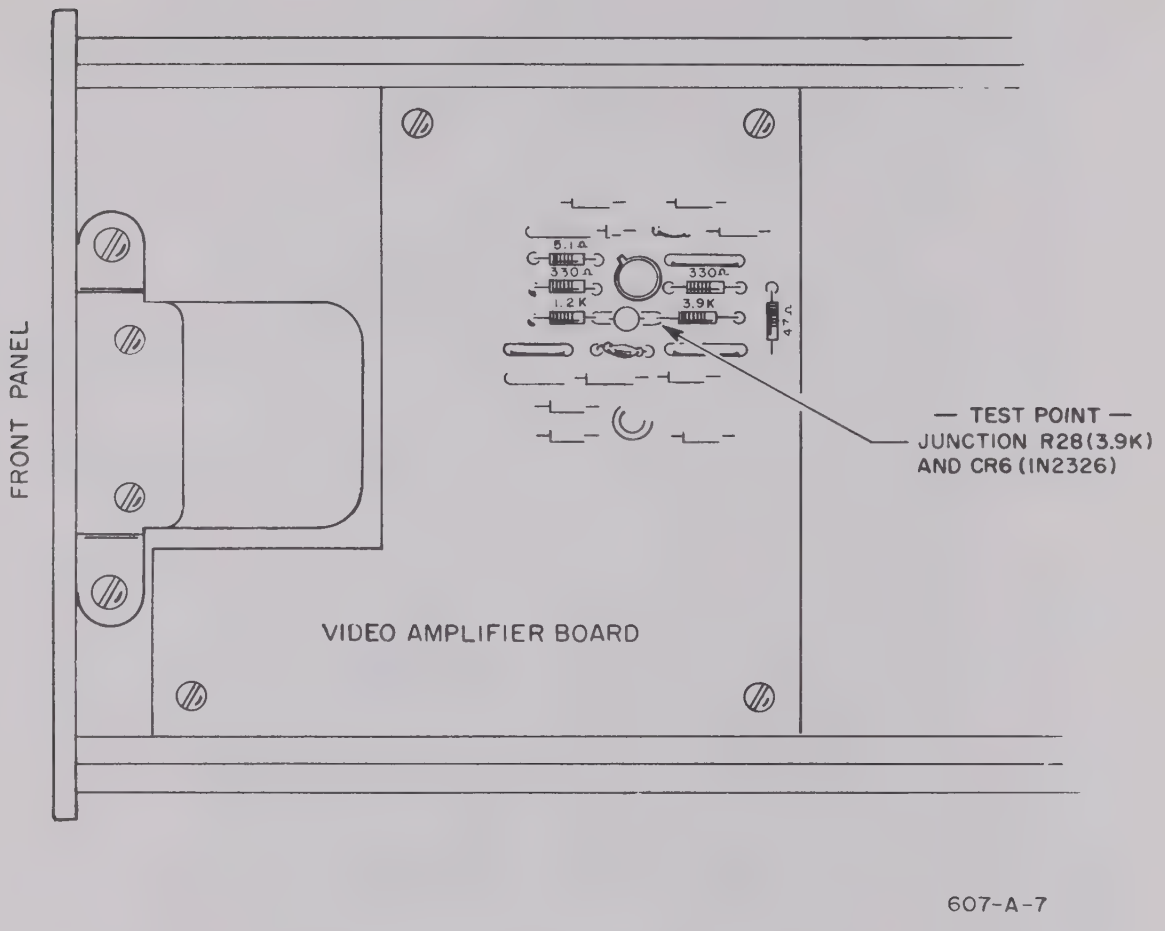


FIG. 4-2. Video Amplifier Board.

4) Adjust C19 for maximum indication on LEVEL meter.

5) Set REFERENCE-MEGACYCLES dial to 180.

6) Apply 181 mc, 100 millivolts rms at INPUT connector.

7) Repeat step (3).

8) Adjust C20 for maximum LEVEL meter indication.

9) Readjust C20 with reference setting of 200 and input of 201 mc for maximum LEVEL indication.

10) Adjust the remaining references (160, 140, 120, 100, 80, 60, 40) using the same method as above. Always readjust the next highest frequency after adjusting the lower frequency, then peak the lower frequency. For example, adjust 160, readjust 180, then readjust 160, etc.

4.6 REFERENCE FREQUENCY ADJUSTMENT (20-30 MC)

Conditions:

1) Unit energized

2) MASTER-PLUG IN selector to PLUG IN

3) Top cover removed

Procedure:

1) Set REFERENCE-MEGACYCLES dial to exactly 30.

2) Apply 31 mc, 100 millivolt rms at INPUT connector.

3) Monitor the signal at the base of Q4, video amplifier board (Figure 4-2) with an oscilloscope. A 1 mc beat frequency should appear if the reference is tuned to the correct harmonic.

4) Adjust C29 (Figure 4-1) for maximum indication on LEVEL meter.

5) Set REFERENCE-MEGACYCLES dial to exactly 20.

6) Apply 21 mc, 100 millivolts rms at INPUT connector.

7) Repeat step (3).

8) Adjust C28 for maximum indication on LEVEL meter.

SECTION 5
PARTS LIST

NOTE

The sub-assemblies contained in this parts list are identified as follows:

Video Amplifier & Filter Assembly	P.C. Board A1
10-20 Mc Multiplier Assembly	P.C. Board A2

Detail No.	Beckman Stock No.	Description	Manufacturer & No.	Qty./ Ass'y
A1	855-413966	Video Amplifier & Filter P.C. Board	Beckman	1
A1C1	637-822757	Capacitor, F. Cerm., 0.001μf, 100V 10%	Sprague 40C387	1
A1C2	637-819444	Capacitor, F. Mica, 33pf, 300V, 5%	Elmenco DM15E330J-300	3
A1C3	637-819446	Capacitor, F. Mica, 68pf, 300V, 5%	Elmenco DM15E680J-300	1
A1C4	637-827574	Capacitor, F. Mica, 56pf, 300V, 5%	Elmenco DM15E560J-300	1
A1C5	637-827575	Capacitor, F. Mica, 18pf, 300V, 5%	Elmenco DM15E180J-300	1
A1C6	637-825071	Capacitor, F. Mica, 27pf, 300V, 5%	Elmenco DM15E270J-300	1
A1C7	633-827605	Capacitor, F. Cerm., 0.01μf, 25V, +80-20%		9
A1C8	633-815873	Capacitor, F. Mica, 0.33μf, 25V	Sprague 5C10A	10
A1C9		Same as A1C8		
A1C10		Same as A1C7		
A1C11 thru A1C13		Same as A1C8		
A1C14	631-802914	Capacitor, F. Elect., 150μf, 15V	Sprague 30D173A1	1
A1C16 & A1C17		Same as A1C7		
A1C18		Same as A1C8		
A1C19		Same as A1C2		
A1C20		Same as A1C7		
A1C21		Same as A1C8		
A1C22	637-827576	Capacitor, F. Mica, 680pf, 300V, 5%	Elmenco DM15E681J-300	1
A1C23 & A1C24		Same as A1C7		
A1C25 thru A1C27		Same as A1C8		
A1C28	633-804701	Capacitor, F. Cerm., 0.001μf, 1000V, CMV	Sprague 40C214	1

Detail No.	Beckman Stock No.	Description	Manufacturer & No.	Qty./ Ass'y
A1C29 & A1C30		Same as A1C7		
A1C31	637-819448	Capacitor, F., Mica, 100pf, 300V, 5%	Elmenco DM15E101J300	1
A1CR1	755-430460	Diode, Special	Beckman	3
A1CR2	755-404593	Diode, Special	Beckman	1
A1CR3 & A1CR4	755-420893	Diode, Special	Beckman	2
A1CR5	755-431324	Diode, Special	Beckman	1
A1CR6	755-819455	Diode, Temp. Compensating	R.C.A. 1N2326	1
A1CR7	755-819394	Tunnel Diode	G. E. 1N3718	1
A1L1	795-413974	Inductor	Beckman	1
A1L2	795-413975	Inductor	Beckman	2
A1L3		Same as A1L2		
A1L4	795-413977	Inductor	Beckman	1
A1Q1	755-817216	Transistor, Germ., PNP, 75mw max.	Philco 2N502A	1
A1Q2	755-819908	Transistor, Silicon, NPN, 300mw 2N834	Motorola 2N834	1
A1Q3	755-824880	Transistor, Germ., PNP, 150mw	Motorola 2N960	1
A1Q4	755-823113	Transistor, Silicon, NPN, 800mw max.	Motorola 2N2219	1
A1Q5	755-413996	Transistor, Special	Beckman	1
A1Q6	755-416237	Transistor, Silicon, NPN, 600mw max.	Beckman	1
A1R1	601-817735	Resistor, F. Comp., 100Ω, 1/4W, 5%	Allen Bradley CB1015	1
A1R2	601-823394	Resistor, F. Comp., 330Ω, 1/4W, 5%	Allen Bradley CB3315	3
A1R3	601-822296	Resistor, F. Comp., 3.3K, 1/4W, 5%	Allen Bradley CB3325	2
A1R4	601-822334	Resistor, F. Comp., 22K, 1/4W, 5%	Allen Bradley 2235	1
A1R5	601-823379	Resistor, F. Comp., 10Ω, 1/4W, 5%	Allen Bradley CB1005	1
A1R6	601-823387	Resistor, F. Comp., 47Ω, 1/4W, 5%	Allen Bradley CB4705	6
A1R7	601-822295	Resistor, F. Comp., 2.7K, 1/4W, 5%	Allen Bradley CB2725	3
A1R8	601-822301	Resistor, F. Comp., 15K, 1/4W, 5%	Allen Bradley CB1535	1
A1R9		Same as A1R3		
A1R10	601-823395	Resistor, F. Comp., 470Ω, 1/4W, 5%	Allen Bradley CB4715	4
A1R11	601-822544	Resistor, F. Comp., 1.8K, 1/4W, 5%	Allen Bradley CB1825	1
A1R12	601-823904	Resistor, F. Comp., 100K, 1/4W, 5%	Allen Bradley CB1045	2
A1R13	601-823386	Resistor, F. Comp., 39Ω, 1/4W, 5%	Allen Bradley CB3905	1
A1R14		Same as A1R10		
A1R15		Same as A1R12		
A1R16		Same as A1R6		
A1R17	601-822327	Resistor, F. Comp., 220Ω, 1/4W, 5%	Allen Bradley CB2215	2
A1R18		Same as A1R10		
A1R20		Same as A1R7		

Detail No.	Beckman Stock No.	Description	Manufacturer & No.	Qty. / Ass'y
A1R21	601-822324	Resistor, F. Comp., 10K, 1/4W, 5%	Allen Bradley CB1035	1
A1R22		Same as A1R6		
A1R23	601-823383	Resistor, F. Comp., 22Ω, 1/4W, 5%	Allen Bradley CB2205	1
A1R24		Same as A1R7		
A1R25	601-822369	Resistor, F. Comp., 680Ω, 1/4W, 5%	Allen Bradley CB6815	1
A1R26	601-822299	Resistor, F. Comp., 6.8K, 1/4W, 5%	Allen Bradley CB6825	1
A1R27	601-822306	Resistor, F. Comp., 820Ω, 1/4W, 5%	Allen Bradley CB8215	2
A1R28	601-822460	Resistor, F. Comp., 3.9K, 1/4W, 5%	Allen Bradley CB3925	2
A1R29	601-822326	Resistor, F. Comp., 1.2K, 1/4W, 5%	Allen Bradley CB1225	1
A1R30		Same as A1R6		
A1R31 & A1R32		Same as A1R2		
A1R33	601-823378	Resistor, F. Comp., 5.1Ω, 1/4W, 5%	Allen Bradley CB51G5	1
A1R34		Same as A1R7		
A1R35		Same as A1R27		
A1R36		Same as A1R28		
A1R37		Same as A1R6		
A1R38		Same as A1R17		
A1R39		Same as A1R10		
A1R40	601-823381	Resistor, F. Comp., 15Ω, 1/4W, 5%	Allen Bradley CB1505	1
	864-412958	Transistor Pad	Beckman	6
	887-819452	Core Toroidal Iron	Radio Cores 57-1556	4
A2	855-413965	10-20 Mc Multiplier P.C. Board Ass'y	B/B	1
A2C1	655-805061	Capacitor, V. Glass, 0.8-18pf, 1000WVDC	JFD Elec. VC4GDL	4
A2C2	637-819448	Capacitor, F. Mica, 100pf, 300V, 5%	Elmenco DM15E101J300	1
A2C3	637-819450	Capacitor, F. Mica, 510pf, 300V, 5%	Elmenco DM15E511J300	2
A2C4		Same as A2C3		
A2C5	633-804701	Capacitor, F. Cerm., 0.001μf, 1000V, CMV	Sprague 40C214	1
A2C6	637-827518	Capacitor, F. Mica, 10pf, 300V, 5%	Elmenco CM15E100J300	1
A2C7		Same as A2C1		
A2C8	633-827605	Capacitor, F. Cerm., 0.01μf, 25V, +80-20%	Sprague 40C387	4
A2C9	633-811294	Capacitor, F. Cerm., 1.5pf, 600V, 10%	Scottie TCD-4-NPO	1
A2C10		Same as A2C1		
A2C11		Same as A2C8		
A2C12	633-811288	Capacitor, F. Cerm., 15pf, 600V, 10%	Scottie TCD-5-NPO	1
A2C13	633-824213	Capacitor, F. Cerm., 2.2pf, 600V, 10%	Scottie TCD-4-NPO	1
A2C14		Same as A2C1		
A2C15	637-819443	Capacitor, F. Mica, 15pf, 300V, 5%	Elmenco DM15E150J300	1
A2C16 & A2C17		Same as A2C8		

Detail No.	Beckman Stock No.	Description	Manufacturer & No.	Qty./ Ass'y
A2L1	795-413969	Inductor, To B/B Spec.	Beckman	1
A2L2	795-413970	Inductor, To B/B Spec.	Beckman	1
A2L3	795-413971	Inductor, To B/B Spec.	Beckman	1
A2L4	795-413972	Inductor, To B/B Spec.	Beckman	1
A2Q1	755-819451	Transistor, Germ., PNP, 60mw, max.	Philco 2N1868	1
A2Q2	755-823113	Transistor, Silicon, NPN, 800mw, max.	Motorola 2N2219	1
A2R1	601-823394	Resistor, F. Comp., 330Ω, 1/4W, 5%	Allen Bradley CB3315	1
A2R2	601-822460	Resistor, F. Comp., 3.9K, 1/4W, 5%	Allen Bradley CB3925	1
A2R3	601-822301	Resistor, F. Comp., 15K, 1/4W, 5%	Allen Bradley CB1535	1
A2R4	601-822527	Resistor, F. Comp., 1.5K, 1/4W, 5%	Allen Bradley CB1525	1
A2R5	601-823375	Resistor, F. Comp., 82Ω, 1/4W, 5%	Allen Bradley CB8205	1
A2R6	601-822296	Resistor, F. Comp., 3.3K, 1/4W, 5%	Allen Bradley CB3325	1
A2R7	601-822369	Resistor, F. Comp., 680Ω, 1/4W, 5%	Allen Bradley CB6815	1
A2R8	601-817735	Resistor, F. Comp., 100Ω, 1/4W, 5%	Allen Bradley CB1015	1
A2R9	601-823391	Resistor, F. Comp., 150Ω, 1/4W, 5%	Allen Bradley CB1515	1
A2R10	601-823383	Resistor, F. Comp., 22Ω, 1/4W, 5%	Allen Bradley CB2205	1
	877-819452	Core, Toroidal Iron	Radio Cores 57-1556	4
	864-412958	Transistor Pad	Beckman	2
C1	633-822757	Capacitor, F. Cerm., .001μf, 100V, 10%	Elmenco DM15C102K-100	1
C2	637-824028	Capacitor, F. Mica, 1000pf, 300V, 5%	Elmenco DM16E102J-300	2
C3	637-841199	Capacitor, Mica Button, 100pf, 500V, 10%	Erie 654-014-010K	1
C4	633-804701	Capacitor, F. Cerm., 0.001μf, 1000V, GMV	Sprague 40C214	2
C5 thru C12	633-827605	Capacitor, F. Cerm., 0.01μf, 25V +80-20%	Sprague 19C604	11
C13	637-819448	Capacitor, F. Mica, 100pf, 300V, 5%	Elmenco DM15E101J-300	4
C14		Same as C5		
C15		Same as C2		
C16		Same as C5		
C17	637-819449	Capacitor, F. Mica, 220pf, 300V, 5%	Elmenco DM15E221J-300	1
C19 thru C29	655-824658	Capacitor, V. Glass, 0.6-14pf, 1000WVDC	JFD Elect. VC-11 GRA-DL	11
C30 & C31	633-811288	Capacitor, F. Cerm., 15pf, 600V, 10%	Skottie TCD-5-Npo	2
C32	633-804704	Capacitor, F. Cerm., 1000pf, 500V	Centralab 327-102	3
C33	633-804706	Capacitor, F. Cerm., 0.001μf, 1000V., 10%	DD102 CRL	1
C34	637-819445	Capacitor, F. Mica, 47pf, 300V, 5%	Elmenco DM15E470J-300	1
C35 thru C37		Same as C13		

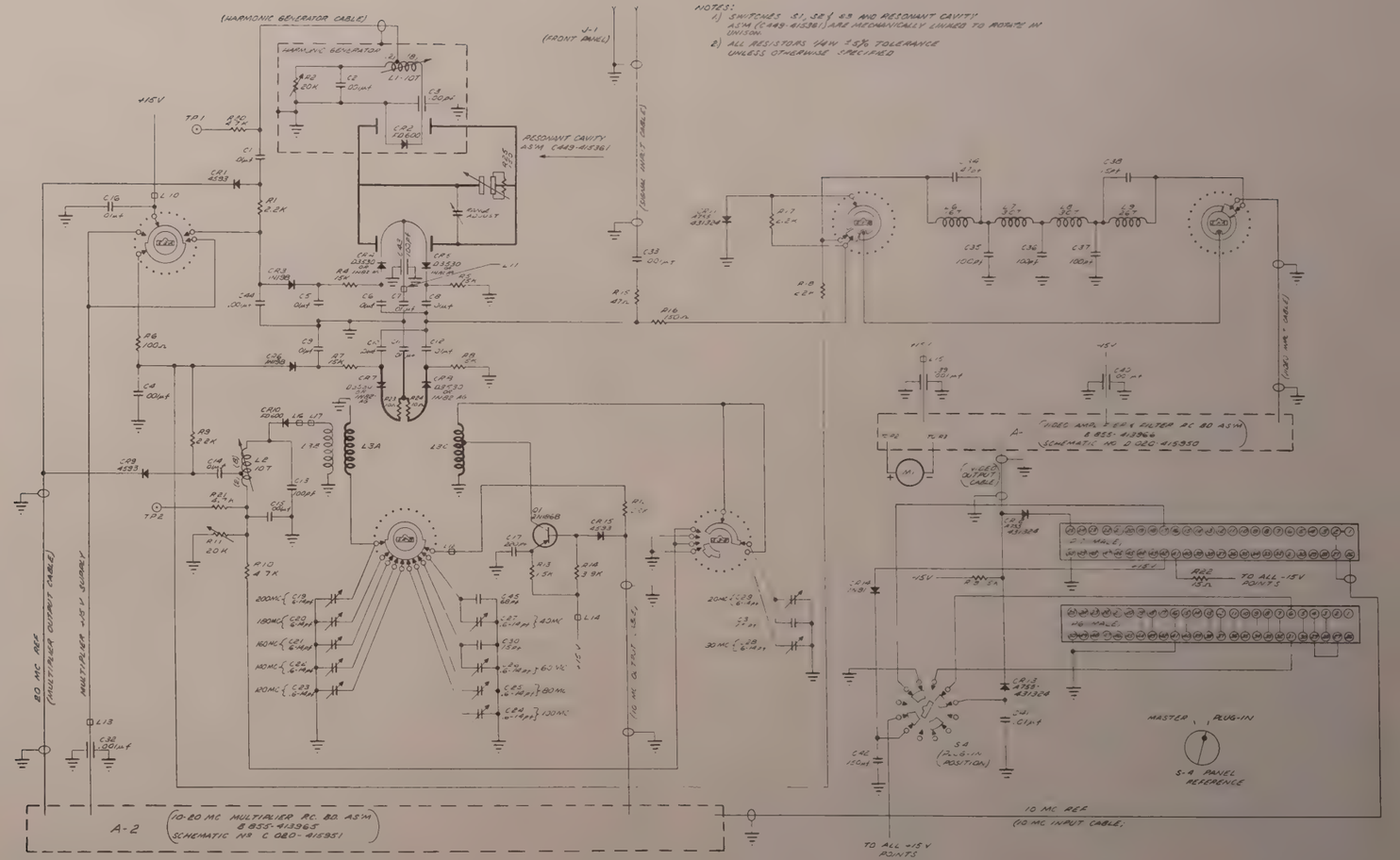
Detail No.	Beckman Stock No.	Description	Manufacturer & No.	Qty. / Ass'y
C38	637-819443	Capacitor, F. Mica, 15pf, 300V, 5%	Elmenco DM15E150J-300	1
C39 & C40		Same as C32		
C41		Same as C5		
C42	631-802914	Capacitor, F. Elect., 150μf, 15V	Sprague TE1163	1
C43	633-827297	Capacitor, F. Cerm., Feed-Thru 100pf, ±20%	Centralab DA740	1
C44		Same as C4		
C45	637-819446	Capacitor, F. Mica, 68pf, 300V, 5%	Elmenco DM15-680J-300	1
CR1	755-404593	Diode, Special	Beckman	3
CR2	755-819904	Diode	Fairchild FD-600	2
CR3	755-409096	Diode, Special	Beckman	2
CR4	755-827873	Diode, Noise Figure 16DB Max	Sylvania D3530	4
CR5		Same as CR4		
CR6		Same as CR3		
CR7 & CR8		Same as CR4		
CR9		Same as CR1		
CR10		Same as CR2		
CR11	755-431324	Diode, Special	Beckman	3
CR12 & CR13		Same as CR11		
CR14	755-001299	Rectifier, Germ., 100PIV, 0.15A Max DC Out	G.E. 1N91	1
CR15		Same as CR1		
J1	670-827519	BNC Bulkhead Jack, Coaxial Panel Conn.	Automatic Metal 120-B3000-81	1
L1	795-414879	Inductor, Harmonic Generator	Beckman	1
L2	795-414880	Inductor, Low Freq. Mixer	Beckman	1
L3	795-415903	Inductor, L.F. Mixer	Beckman	1
L6	795-413975	Inductor	Beckman	1
L7	795-413979	Inductor	Beckman	2
L8		Same as L7		
L9	795-413978	Inductor	Beckman	1
L10	783-807862	Ferrite Bead	Ferroxcube 208F125-102	8
L11 thru L17		Same as L10		
P6	672-824945	Connector, Plug, 50 Male Contacts	Amphenol 57-10500	2
P7		Same as P6		
M1	809-414920	Intern'l Inst. Meter, per Beckman Spec. #1120 HBL 200μA	Beckman	1
Q1	755-819451	Transistor, Germ., PNP, 60mw, max.	Philco 2N1868	1

Detail No.	Beckman Stock No.	Description	Manufacturer & No.	Qty. / Ass'y
R1	601-822328	Resistor, F. Comp., 2.2K, 1/4W, 5%	Allen Bradley CB2225	4
R2	611-827596	Resistor, V. W.W., 20K, 1/2W, 20%	Bourns 3067S-1-203	2
R4	601-822301	Resistor, F. Comp., 15K, 1/4W, 5%	Allen Bradley CB1535	5
R5		Same as R4		
R6	601-817735	Resistor, F. Comp., 100Ω, 1/4W, 5%	Allen Bradley CB1015	1
R7 & R8		Same as R4		
R9		Same as R1		
R10	601-822297	Resistor, F. Comp., 4.7K, 1/4W, 5%	Allen Bradley CB4725	3
R11		Same as R2		
R12	601-822334	Resistor, F. Comp., 22K, 1/4W, 5%	Allen Bradley CB2235	1
R13	601-822527	Resistor, F. Comp., 1.5K, 1/4W, 5%	Allen Bradley CB1525	1
R14	601-822460	Resistor, F. Comp., 3.9K, 1/4W, 5%	Allen Bradley CB3925	1
R15	601-823387	Resistor, F. Comp., 47Ω, 1/4W, 5%	Allen Bradley CB4705	1
R16	601-823391	Resistor, F. Comp., 150Ω, 1/4W, 5%	Allen Bradley CB1515	2
R17 & R18		Same as R1		
R19		Same as R4		
R20 & R21		Same as R10		
R22	601-823381	Resistor, F. Comp., 15Ω, 1/4W, 5%	Allen Bradley CB1505	1
R23	601-823379	Resistor, F. Comp., 10Ω, 1/4W, 5%	Allen Bradley CB1005	2
R24		Same as R23		
R25		Same as R16		
S1	711-413646	Switch, Front Wafer	Beckman	1
S2	711-413647	Switch, Middle Wafer	Beckman	1
S3	711-413648	Switch, Rear Wafer	Beckman	1
S4	711-415101	Switch, Power - Oak Type A	Beckman	1
	325-415351	Knob	Beckman	1
	201-043789	Gear, Spur, 66 teeth, Brass	Boston Gear G145	3
	325-827599	Crank Knob, Matte - Black 1/4" Shaft	Raytheon 125-6-2G	1
	647-414842	Rotor Ass'y, Hammarlund Type MC-M Mod	Beckman	1
	201-004245	Gear, Miter, 24 teeth, Brass	Boston Gear G463Y	2
	778-415100	Switch Shield, Oak Type, M. F.	Beckman	1
	661-404746	Cable, 10 Conductor	Beckman	18"
	661-827598	Coax. Cable, RG/U 50Ω	Amphenol 21-44 (RG122/U)	41"
	661-807981	Cable, Coaxial, 95Ω	William Brand 2152	30-1/2
	301-416014	Idler Spring	Beckman	2
	125-099428	Pin, Spring, 0.062 dia. x 5/16	Standard Press Steel Co.	4
	125-023902	Pin, Spring, 0.062 x 0.375	Standard Press Steel Co.	1
	433-413322	Rear Panel	Beckman	1
	433-414701	Front Panel Bezel	Beckman	1

Detail No.	Beckman Stock No.	Description	Manufacturer & No.	Qty. / Ass'y
	449-413463	Assembly, Securing Rod	Beckman	1
	325-413461	Knob, Securing Rod	Beckman	1
	433-415128	Front Panel Assembly	Beckman	1
	226-415010	Cam Follower Assembly	Beckman	1
	201-416010	Pinning Assembly, Spring Idler	Beckman	1
	771-415009	Resonant Cavity Assembly	Beckman	1
	201-414939	Pinning Assembly, Idler Pinion	Beckman	1
	223-414939	Pinning Ass'y, Gear Reduction Output Shaft	Beckman	1
	449-414733	Pinning Ass'y, Drum Pivot Shaft	Beckman	1
	327-415362	Support Bracket, Ass'y, Harmonic Gen.	Beckman	1
	153-415363	Pivot Stud, Harmonic Generator	Beckman	1
	338-414846	Support Bracket, Harmonic Generator	Beckman	1
	299-415011	Base Plate Ass'y, Harmonic Generator	Beckman	1
	778-415287	L. F. Shield Assembly	Beckman	1
	778-415367	Shield Ass'y, L. F. Harmonic Generator	Beckman	1
	349-414731	Indicator Drum	Beckman	1
	507-414770	Drum Window	Beckman	1
	208-414843	Cam, Harmonic Generator	Beckman	1
	297-414906	Rear Rotor Bearing Cap	Beckman	1
	297-414905	Front Rotor Bearing Cap	Beckman	1
	130-414907	Retainer, Contact Spring	Beckman	2
	724-416312	Contact Spring, Formed	Beckman	2
	647-414847	Stator	Beckman	1
	655-414912	Trim Capacitor Rotor	Beckman	1
	655-414911	Trim Capacitor Stator	Beckman	1
	201-416011	Gear, Spring, Mod.	Beckman	1
	201-414687	Drive Pinion	Beckman	1
	161-414736	Spacer, Video Board	Beckman	4
	161-414737	Spacer, Multiplier Board	Beckman	4
	338-414735	Meter Holding Strap	Beckman	1
	349-414838	Cover, Harmonic Generator	Beckman	1
	125-414839	Control Pin, Harmonic Generator	Beckman	1
	678-415677	Coax. Cable Header	Beckman	2
	327-415096	Mixer Bracket	Beckman	1
	302-415095	Mixer Spring	Beckman	1
	778-415288	Shield, Capacitor	Beckman	1
	327-414829	Bracket, Coax. Termination	Beckman	1
	778-415366	Grounding Mesh Pad	Beckman	1
	798-414831	L. F. Coil Form	Beckman	1
	167-414830	Spacer, Cavity Bracket	Beckman	1
	160-415047	Switch Spacer, Short	Beckman	4
	160-415048	Switch Spacer, Long	Beckman	4
	430-414910	Mixer Mounting Plate	Beckman	1

Detail No.	Beckman Stock No.	Description	Manufacturer & No.	Qty./ Ass'y
	729-414909	Switch Shaft	Beckman	1
	327-415289	Rear Panel Adaptor	Beckman	1
	778-416566	10 Mc Filter Shield	Beckman	1
	101-415904	Threaded Rod, Switch	Beckman	2
	864-416311	Cover, Insulator Harmonic Generator	Beckman	1
	449-415361	Resonant Cavity Assembly	Beckman	1
	771-415126	Cavity, Trim Capacitor Assembly	Beckman	

MODEL 607
MASTER
SCHEMATIC DIAGRAM



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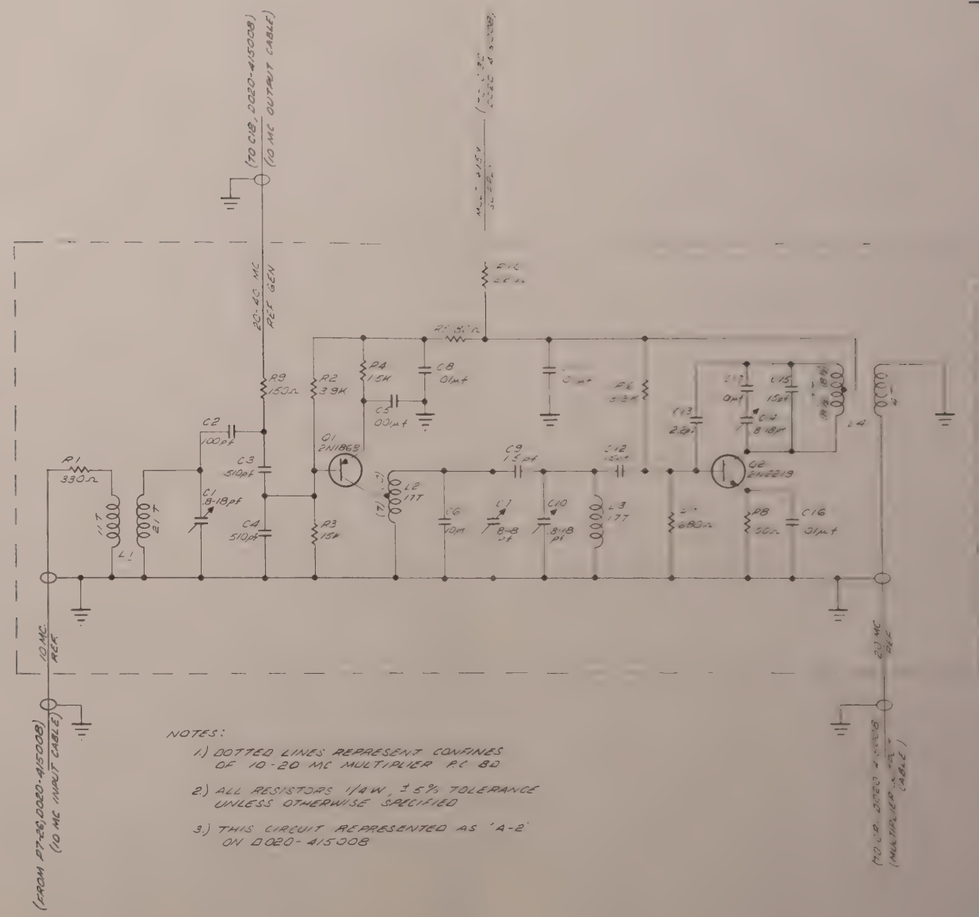
MODEL 607
10-20 MC MULTIPLIER
SCHEMATIC DIAGRAM



NOTES:

1.) DOTTED LINES REPRESENT CONFINES OF 10-20 MC MULTIPLIER PC 80

2.) ALL RESISTORS 1/4W, ±5% TOLERANCE UNLESS OTHERWISE SPECIFIED

3.) THIS CIRCUIT REPRESENTED AS 'A-2' ON D020-415008

Model 607
C 415951 - Rev. B
July 1963

Beckman®

MODEL 607
VIDEO AMPLIFIER & FILTER
SCHEMATIC DIAGRAM

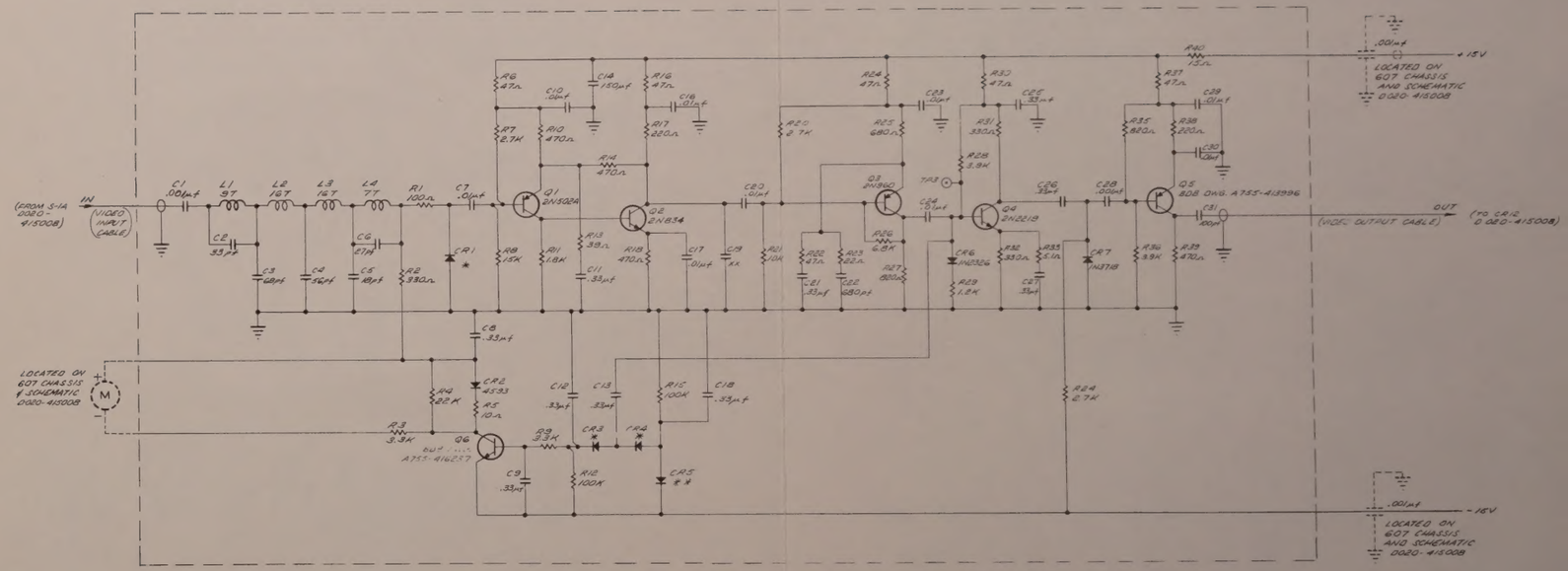
NOTES:

1) DOTTED BOUNDARY LINE REPRESENTS CONFINES OF VIDEO AMPLIFIER & FILTER PRINTED CIRCUIT BOARD

2) ALL RESISTORS 1/4W ±5% TOLERANCE UNLESS OTHERWISE SPECIFIED

3) THIS CIRCUIT REPRESENTED AS "A-1 ON D 020-415008

4) * DIODES ARE BII A755-430460 -
** DIODES ARE BII A755-431324.
*** DIODES ARE BII A755-420893



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ME 1309
BECKMAN
HETERODYNE CONVERTER, MODEL 607

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